

SatFACTS EXTENDED

Volume 14 - #168

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Editor's note: Mike Kohl (www.global-cm.net; email globalcm@mhtc.net) is a survivor, one of the last remaining, active 'originals' from the exciting 'C-Band Days' that began late in the (19)70s and extended for a fortunate few into the lower 90s. Mike continues to believe in C-band (3.7-4.2GHz), that with suitable engineering it remains the most cost-effective and wide-coverage satellite-to-earth technical option available to broadcasters. His May (2008) visit to the eastern Siberia Kupol mine site was his second. The challenge was to provide English and Russian television (and radio) to a large staff of well paid but totally isolated workers (and management); see box material to right. Here is Mike's report.

"You may recall my December trip (2006) which sent me from middleland Wisconsin to Eastern Siberia via Moscow; traveling at that time around 3/4 of the planet to reach a point actually (in planetary terms) quite close to my home base. This, second, trip was far easier on my body; barely two days from Madison (Wisconsin) to Minneapolis to Anchorage to Nome (Alaska) on commercial flights, followed by a pair of charters to the final destination. From Nome across the Bering Strait to the Russian port of entry (Anadyr in the Chukotka Region) and then via chartered Vostok to the remote Kupol mine site was one of those experiences which has to be done in person to appreciate. I was arriving just as 24-hour-per-day sunlight did and in the three weeks I would be at Kupol creating a suitable satellite reception and cable distribution system, the brilliant never-ending sunlight would cause 9 months of accumulated snowfall to shrink almost as one watched.

"My personal history includes 13 years as a resident of 'The Arctic' (Alaska) but never actually above the 'circle' for a prolonged period of time. The adjustment one must make is that our sun remains visible, bright, strong, 24 hours for several months. Even with good window shades held in place with duct tape it is impossible to ignore the brightness and after a week or two it will wear one down

Kupol Mine - Not quite at the end of the world *.... but if you arrive and turn right, you will be there!*

The numbers are staggering. The original investors put US\$280 million into development of a vein of gold and silver at depths to 500 metres in one of the most remote locations of far northern Siberia. The current owners have increased the investment to US\$705 million and this month the facility begins processing gold and silver out of ground. They expect the processed gold to cost around US\$205 an ounce in a marketplace where the metal is currently selling for around US\$861 on the wholesale market. Silver, at US\$6 an ounce, will be a 'by-product'. The engineers calculate they will initially recover around 4,446,000 ounces gold, 54, 226,000 ounces of silver. At \$400 an ounce, that comes to a gross value of gold US\$1,778,400,000 and silver of US\$3,253,560,000. The anticipated net profit out of all of this is roughly 50 cents on the dollar; US\$2.5 billion at gold US\$400.

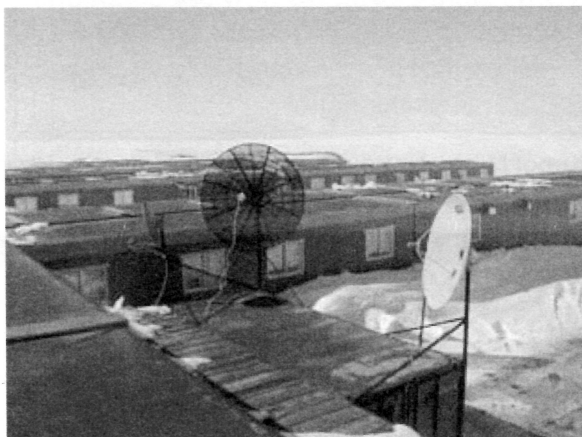
How do you keep more than 600 workers reasonably happy encamped in one of the most remote and weather-unfriendly regions of the world where 'winter' lasts more than nine months of the year? *That was Mike Kohl's assignment.*

because of a cumulative lack of adequate sleep. My previous trip during the month of December was of course the 180 degree reversal of this experience; the sun *never* came up!

The technology

"This trip began with a pair of TRUE FOCUS 3.7m prime focus antennas, installed on some superbly crafted towers welded into place and rigidly connected to mother earth with who knows how much cement and rebar steel by mine personnel in advance of my arrival. My first trip had established the parameters of what was required and plans left behind were followed perfectly.

In this issue: Satellite TV at 'the top of the world'



What I left behind in 2006; temporary mounts onto a shipping container. This was thrown together in pitch darkness and -30C temperatures in the middle of winter so no accounting for workmanship! SVEC mesh antenna (2.3m) looking at AMC-8, 5.5 degrees elevation. Paracclipse 90cm offset looking at Ku-side of 140E. The 90 cm has been moved while the 2.3m mesh has been retrofitted with true ADL circular feed (+ LNB) for reception from 140E. Everything here has since been moved (during the brief summer spell) onto permanent cemented masts.

"Antennas were pointed at 139W (AMC-8) and 166E (Intelsat 8) for C-band reception of television and radio signals. An existing 2.3m (8 foot) mesh antenna was modified with a (ADL) circular feedhorn for primary reception from the Russian satellite at 140E (C-band) for both TV and radio. Still more Russian signals were from the Ku-band side of this same satellite using a separate 90cm offset antenna which literally pointed 15 degrees into the ground (see photo directly above). A 7 degree elevation angle with an offset antenna equals a reflector that is pointing 15 degrees past vertical providing an unusual and somewhat strange appearance!

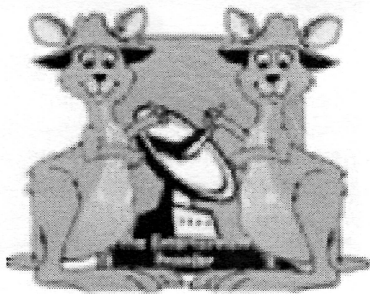
"The camp has a very international flavor, with as many as 600+ workers plus a steady stream of short-timers who come and go on the chartered Vostok 19 seat airplanes or the choppers. The primary mine operator is a Canadian firm but the work force is

166E in near view on custom locally produced welded steel structure and buried in who knows how much concrete and steel. These miners know something about survival of equipment in a very unfriendly environment, reminding me of the special skills I have witnessed at oil-field sites where dish systems have been installed.

Everything is VERY stout!

worldwide including many Canadians and a smattering of Americans. Twenty-five percent of the facility has been retained by the local (Chukotka) government and as would be expected, hundreds of Russians. The Chukotka 'autonomous region' is large and sparsely settled and the mine is actually in a subarea known as 'The Bilibinski District'. The ten year population figure, setting aside the mine's recent arrival, has shown a significant loss - more than 25% of the region's residents have moved to warmer climes in a decade. In a phrase, 'the mine is the biggest thing that has ever happened up here' - which happens to be at 66 degrees 47 minutes north and 169 degrees 33 minutes east (roughly *due north* of PAS/Intelsat 2).

"Because of the short period of 'summer' and the limited ability to accomplish much during this restricted light-period, the community is essentially designed to be inside-out; people work outside (the mine shafts go to as deep as 500 metres) and live inside. All recreation areas are enclosed and designed to withstand horrendous winds and snowfall accumulation. Ex-pat workers, perhaps out of ignorance or based upon optimism, arrive packing



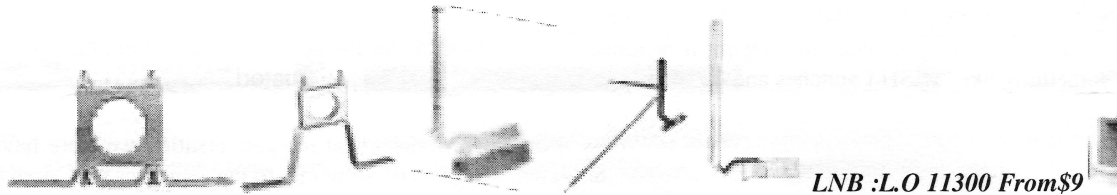
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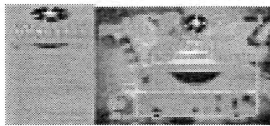
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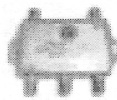
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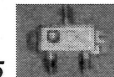


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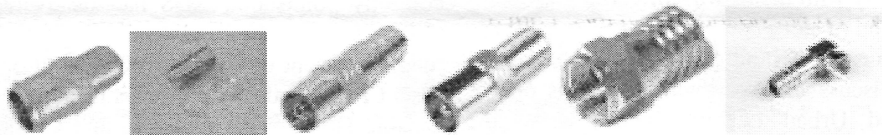
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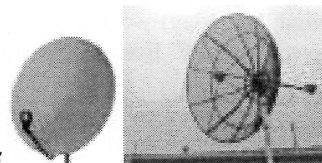
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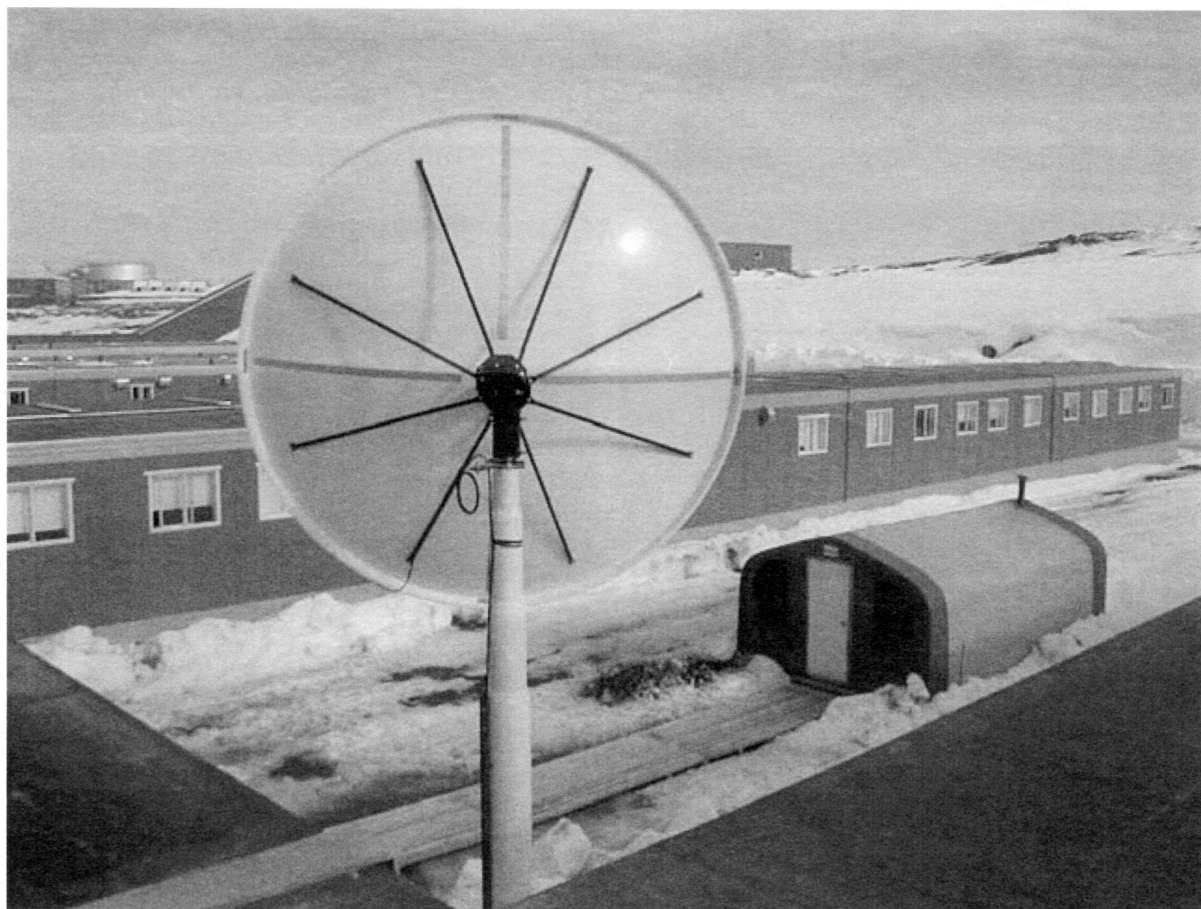
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TRUE FOCUS 3.8m pointing at AMC-8 (139W) with a 5.5 degree elevation angle. The structure to right of antenna is a 'Smoker's Tent' - even here at 'the end of the earth' anti-smoking rules exist (prohibited within the facility proper).

their home-town projection TV sets, stereo systems, whatever it takes to 'get through the night'. So in designing a TV and radio distribution system, the users end up with a mixture of all three standards - PAL, SECAM and NTSC as well as FM radios that may have been designed for a 75 uS de-emphasis region of the world but now in one where who knows whether it should be 50 uS - or what! Needless to say, there are no terrestrial transmitters (AM, FM or TV) within flying distance in any direction. It is satellite, or recorded material.

"More than 20 channels are now being distributed representing English language programming through Alaskan and Asia-Pacific sources. Popular Russian channels are simulcast by the system in NTSC and PAL formats to allow backwards compatibility for the North American sourced big screen TVs as well as of course in PAL for sets with multi-standard ability. 'Local' (read

between the lines here!) sourced materials (think DVD player) is also accommodated. Yes, in Russia SECAM is the 'official' TV system but when one considers 'where' we are here, it is difficult to make a persuasive argument for using SECAM modulators when PAL (and NTSC) are so much more available, are of much higher quality (reliability is a big deal here 'at the end of the earth'), and certainly less expensive. And most SECAM receivers will at least function with a PAL signal whereas the reverse is not true.

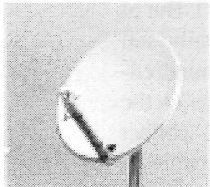
"Distribution? Think cable TV with the ability to 'radiate outward' at chosen locations, through the air, over short distances. Just as an example, think of +100 dBuV flowing through suitable cable, with a -8 dB tap inserted into the line and that tap then connected to a dipole antenna designed to function at (say) 100 MHz. That delivers +92 dBuV into the antenna which when fed with FM band signals equals radiated coverage of tens of

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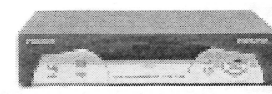


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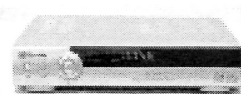
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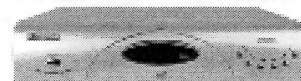


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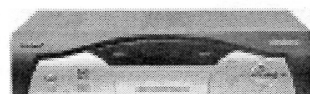


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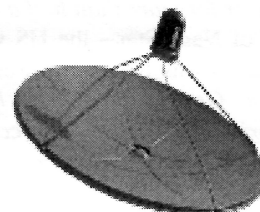
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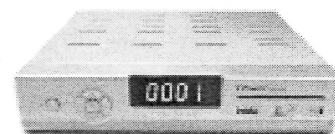
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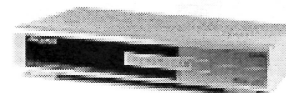


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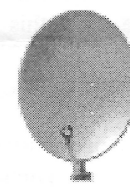


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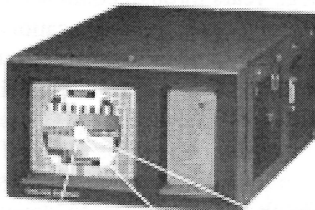
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The 'other' 3.7m TRUE FOCUS pointing at 166E (PAS/Intelsat 8) at approximately 14 degrees elevation. Even in summer that is a 'snow field' dominating the western horizon.

metres. Think of this as 'open circuit-closed circuit distribution', in both English and Russian.

Reception testing

"One technical detail you do not have to worry about here is LNB 'cooling'! If it is true (and it seems to be) that LNBs function better (lower noise, more stable gain) when the temperatures are cold - well, this installation has it made!

"The original SVEC 2.3m mesh antenna (installed late in 2006) basically 'came out of service' on this trip which provided an opportunity to do some sky-scanning from this unusual location at/above the Arctic Circle. One usually begins such a quest by going to a respected reference source such as Lyngsat and dialing up the footprint coverage maps (which are provided by the satellite operators; Lyngsat is not responsible for what the maps depict). The highest elevation angle we would find is around 14 degrees while local terrain prevents

looking below 1.5 degrees. Standard 'knowledge' says that anything below 5 degrees is not worth attempting because of a combination of earth noise (getting into the feed) and low angle atmospheric propagation effects. Understand what I tried on this late-May/early June trip was in the best possible part of the year (i.e. there were no blizzards while I was there).

"The bottom line first; my results were better (far better in fact) than predicted contours. I was unable to clear the terrain for AsiaSat 5 (105.5E; 1.2 degrees elevation) but conversely was able to get down to 127W (Galaxy 13) at 1.5 degrees. What I found was absolutely 'smoking levels' from 127W and 133W despite their 1.5 and 3.5 degree elevation levels. There was no (usable) sign of 129, 131 and 135W but very usable levels from 137 and 139W. And I developed a new line of rationale for using smaller antennas - i.e. the common response to 'not enough signal - *but something*' is to make the antenna

larger. Perhaps not. One side effect of a smaller antenna is a wider beamwidth of course. Where this appears to be a plus is that when signals arrive at such low look angles, there are subtle, sometimes very rapid, variations in signal levels as the near field (local) atmosphere undergoes changes in refractive index (that is the combination of moisture in the air, temperature, and 'layering' of various temperature streams in the lower atmosphere). In effect, that last 100 miles or so of signal pathway cuts through the near-earth atmosphere at a relatively low angle; a signal that is 1.5 degrees above the horizon by line of sight is only 1.5 degrees away from being a terrestrial signal coming in along the horizon to you. When the antenna 'beamwidth' becomes tight (i.e. the antenna is physically larger and the beamwidth narrows) the focal line of the antenna apparently becomes too sharp; a signal that was one moment arriving at 1.5 degree elevation is 'bent' by the atmospherics and for some period of time (perhaps measured in milliseconds) it arrives at 1 degree elevation or 3 degree elevation. It is as if the satellite was hopping up and down in space when in fact it is only the signal that is doing the hopping and then only in the last hundred or so miles it travels through the lower layers of the atmosphere.

"My previous experience in Alaska had pointed me in this direction; bigger antennas produced more gain when signals were stable (i.e. without effects from the atmosphere) while on other days under differing 'local' weather conditions, the signal swings were quite large, more so on a larger aperture antenna than on a smaller one with a wider frontal beamwidth.

"I had the luxury of time to test this theory on 133W. The 2.3m antenna was producing mid-20s signal quality from (such as - I am not going to be more specific here!) 'The California Channel' and this matches what I have at home in central Wisconsin. Other (no, not specific) 133W channels produced mid-70 levels (that is the 'quality' reading, folks). On 127W I was dumbstruck by the quality of BBC World and RFD-TV (for example) on my trusted Traxis DBS-3500 MPEG-2 FTA receiver. Just for grins I left the receiver running on RFD-TV for several hours with the quality meter display functional and recorded this on a DVD. During that period, even with what I would characterize as 'clear air', I never lost the signal although it would show (quality) variations as high as 15 points in a 60 second time span.

"From a design perspective, there would appear to be a fine line between antenna gain (size) and forward beamwidth. Too small and you don't have enough signal 'on average' and too large you have more signal at peak times but no more (or worse levels) when the atmosphere effects crank up.

"Another element at Kupol is of course the on-site weather. Hurricane/cyclone force winds are very

common which frequently places major demands on the antennas, the structure supporting the antennas, and perhaps most of all the stability of the dish when there is a gale blowing. A smaller dish with a broader beamwidth will collect less wind, move less, and in the process be less likely to have the forward lobe shift out of the desired boresight direction.

"The most recent Russian satellites are capable of supplying +48 dBw on C-band into regions such as Eastern Siberia. What this means in the general area (there are some small communities of 1,000 to 1,200 people within 100 miles of the site) is that even on C-band dishes as small as 75cm will function and because of their small size and (really!) broad beamwidth can withstand a significant amount of physical battering by winds and still produce useful reception.

"What I have learned here is to innovate, not be afraid of trying simply because someone has pre-forecast it will not work 'there'. For now and for the next decade or so that the Kupol Mine is scheduled to be functional, at least the folks who live and work there will not be disconnected from the balance of the planet. I arrived home in Wisconsin quite sure I had done a good deed for those people, and would be appropriately rewarded in due course."

...

Editor's note: The 'lessons' from Mike Kohl are universal, hardly limited to Chukotka region in Siberia. Perhaps the most important data relates to the widely varying signal levels (as translated to signal 'quality') for low look angle signals. This is NOT new wisdom, but it is useful to remember when attempting installations where the elevation angle is below 5 degrees (C-band) or 8 degrees (Ku where the effects of the atmosphere are even more severe).

...

Update Abbreviated:

Optus C1/156E: "The 'Info 156E' channel (12.407V, Sr 30.000, 2/3) in mid-July warned users there would be an 'update July 22-23' requiring users to leave their (Aurora service) STB switched on. If they in fact sent new software, my Version 1 Aurora card took 20 seconds to decrypt on the 24th; perhaps this update was limited to Version 2 cards, or the infamous gold/silver/white cards?" (IF, Qld.) "Foxtel is now running (12.720H, 27.800, 3/4) a sixth HD channel which is not labeled; VPID1031, APID (AC3 only) 1032. It is 'HD Movies on Demand', the channel is not viewed live - it feeds an iQ2 STB for delayed recording and if - when - the viewer selects to watch the recorded movie, the phone line connection reports this to Foxtel and *Bingo!* the subscriber is billed." (IF, Qld.)

Soap Box: "Reference SFE # 167, p. 7 and 'How did they make iPhones cook popcorn' (as a health warning to viewers)? Microwave oven under table, door open." (IF)

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